

CLAIMS

What is claimed is:

1 *Sub A2* 1. A method for providing pacing therapy to a heart, comprising the
2 steps of:
3 (a) establishing discrimination criteria for distinguishing between
4 different types of supraventricular tachycardia;
5 (b) sensing activity of at least one of the atria of the heart to provide an
6 atrial activity signal;
7 (c) comparing at least one characteristic of the atrial activity signal to the
8 discrimination criteria to identify the type of supraventricular tachycardia occurring; and
9 (d) controlling pacing of the heart in a manner corresponding to the type
10 of supraventricular tachycardia identified.

1 2. The method of Claim 1 wherein the step of establishing
2 discrimination criteria includes the step of establishing criteria for distinguishing between at
3 least two different types of regular rapid heart rates due to a pacemaker anywhere above a
4 ventricular level.

1 *Sub A3* 3. The method of Claim 2 wherein the step of establishing
2 discrimination criteria includes the step of establishing criteria for distinguishing between
3 fast atrial flutter and a slower rate supraventricular tachycardia.

1 4. The method of Claim 3 wherein the step of establishing
2 discrimination criteria includes the step of establishing criteria for distinguishing between
3 fast atrial flutter at a first high rate and an other atrial flutter at a second lower rate.

1 5. The method of Claim 1 wherein the step of establishing
2 discrimination criteria includes the step of establishing rate-based discrimination criteria for
3 distinguishing between different types of supraventricular tachycardia and wherein the step
4 of comparing at least one characteristic of the atrial activity signal to the discrimination
5 criteria includes the step of comparing a rate of the atrial activity signal to the
6 discrimination criteria.

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6. The method of Claim 1 wherein the step of establishing discrimination criteria includes the step of establishing morphology-based discrimination criteria for distinguishing between different types of supraventricular tachycardia and wherein the step of comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes the step of comparing a morphology characteristic of the atrial activity signal to the discrimination criteria.

7. The method of Claim 1 wherein the step of establishing discrimination criteria includes the step of establishing a multi-dimensional threshold function, and wherein the step of comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes the step of comparing a combination of a plurality of statistics calculated from a set of depolarization intervals determined from the atrial activity signal to the threshold function.

8. The method of Claim 1 comprising additionally the step of monitoring an effect of controlling pacing of the heart in a manner corresponding to the type of supraventricular tachycardia identified, and automatically adjusting the discrimination criteria in response thereto.

9. The method of Claim 1 wherein the step of controlling the pacing of the heart in a manner corresponding to the type of supraventricular tachycardia identified includes the steps of providing atrial antitachycardia pacing to the heart or an other type of pacing control depending upon the type of supraventricular tachycardia identified.

10. The method of Claim 9 wherein the other type of pacing control is ventricular pacing.

11. The method of Claim 10 wherein the other type of pacing control is selected from the group of pacing controls consisting of ventricular rate regulation and Rate Smoothing.

12. The method of Claim 1 wherein the step of comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes the step of applying an atrial discrimination algorithm to the atrial activity signal to produce an atrial

discrimination algorithm output value indicative of the type of supraventricular tachycardia occurring.

13. The method of Claim 12 comprising additionally the step of trending a plurality of atrial discrimination algorithm output values and controlling timing of the pacing of the heart in a manner corresponding to the type of supraventricular tachycardia identified in response to the trend of the atrial discrimination algorithm output values.

14. A method for providing pacing therapy to a heart, comprising the steps of:

(a) establishing discrimination criteria for distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia;

(b) sensing activity of at least one of the atria of the heart to provide an atrial activity signal;

(c) comparing at least one characteristic of the atrial activity signal to the discrimination criteria to identify whether a fast atrial flutter or a slower rate supraventricular tachycardia is occurring; and

(d) controlling pacing of the heart to provide atrial antitachycardia pacing to the heart if a slower rate supraventricular tachycardia is identified as occurring and providing an other type of pacing control if a fast atrial flutter is identified as occurring.

15. The method of Claim 14 wherein the step of establishing discrimination criteria includes the step of establishing criteria for distinguishing between the fast atrial flutter at a first high rate and an other atrial flutter at a second lower rate.

16. The method of Claim 14 wherein the step of establishing discrimination criteria includes the step of establishing rate-based discrimination criteria for distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia and wherein the step of comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes the step of comparing a rate of the atrial activity signal to the discrimination criteria.

17. The method of Claim 14 wherein the step of establishing discrimination criteria includes the step of establishing morphology-based discrimination

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3 criteria for distinguishing between fast atrial flutter and a slower rate supraventricular
4 tachycardia and wherein the step of comparing at least one characteristic of the atrial
5 activity signal to the discrimination criteria includes the step of comparing a morphology
6 characteristic of the atrial activity signal to the discrimination criteria.

1 18. The method of Claim 14 wherein the step of establishing
2 discrimination criteria include the step of establishing a multi-dimensional threshold
3 function, and wherein the step of comparing at least one characteristic of the atrial activity
4 signal to the discrimination criteria includes the step of comparing a combination of a
5 plurality of statistics calculated from a set of depolarization intervals determined from the
6 atrial activity signal to the threshold function.

1 19. The method of Claim 14 comprising additionally the step of
2 monitoring an effect of the step of controlling pacing of the heart, and automatically
3 adjusting the discrimination criteria in response thereto.

1 20. The method of Claim 14 wherein the other type of pacing control is
2 ventricular pacing.

1 21. The method of Claim 20 wherein the other type of pacing control is
2 selected from the group of pacing controls consisting of ventricular rate regulation and Rate
3 Smoothing.

1 22. A method for distinguishing between different types of rapid regular
2 supraventricular tachycardia, comprising the steps of:

3 (a) establishing an atrial discrimination algorithm including
4 discrimination criteria for distinguishing between different types of rapid regular
5 supraventricular tachycardia;

6 (b) sensing activity of at least one of the atria of the heart to provide an
7 atrial activity signal;

8 (c) applying the atrial discrimination algorithm to the atrial activity
9 signal to compare at least one characteristic of said atrial activity signal to the
10 discrimination criteria to identify the type of rapid regular supraventricular tachycardia
11 occurring; and

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(d) providing an indication corresponding to the type of rapid regular supraventricular tachycardia identified.

23. The method of Claim 22 wherein the step of establishing an atrial discrimination algorithm includes the step of establishing discrimination criteria for distinguishing between fast atrial flutter and a slower rate rapid regular supraventricular tachycardia.

24. The method of Claim 22 wherein the step of establishing an atrial discrimination algorithm includes the step of establishing discrimination criteria for distinguishing between fast atrial flutter at a first high rate and an other atrial flutter at a second lower rate.

25. The method of Claim 22 wherein the step of establishing an atrial discrimination algorithm includes the step of establishing rate-based discrimination criteria for distinguishing between different types of rapid regular supraventricular tachycardia and wherein the step of comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes the step of comparing a rate of the atrial activity signal to the discrimination criteria.

26. The method of Claim 22 wherein the step of establishing an atrial discrimination algorithm includes the step of establishing morphology-based discrimination criteria for distinguishing between different types of rapid regular supraventricular tachycardia and wherein the step of comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes the step of comparing a morphology characteristic of the atrial activity signal to the discrimination criteria.

27. The method of Claim 22 wherein the step of establishing an atrial discrimination algorithm includes the step of establishing a multi-dimensional threshold function, and wherein the step of applying the atrial discrimination algorithm to the atrial activity signal includes the step of comparing a combination of a plurality of statistics calculated from a set of depolarization intervals determined from the atrial activity signal to the threshold function.

28. The method of Claim 22 comprising the additional steps of establishing a maximum atrial tracking rate, deriving an atrial rate from an atrial activity signal, and comparing the derived atrial rate to the maximum atrial tracking rate, and wherein the step of applying the atrial discrimination algorithm to an atrial activity signal is performed only if the derived atrial rate exceeds the maximum atrial tracking rate.

29. The method of Claim 22 comprising the additional step of controlling pacing of a heart in a manner corresponding to the type supraventricular tachycardia identified.

30. A cardiac pacing device, comprising:

(a) sensing means for sensing activity of at least one of the atria of a heart;

(b) signal detection means coupled to the sensing means for generating an atrial activity signal based on the sensed activity of the atria of the heart;

(c) a pacer for providing pacing pulses to the heart; and

(d) a processor coupled to the signal detection means for receiving the atrial activity signal and to the pacer for comparing at least one characteristic of the atrial activity signal to discrimination criteria for distinguishing between different types of supraventricular tachycardia to identify the type of supraventricular tachycardia occurring and for controlling the pacer to provide pacing pulses to the heart in a manner corresponding to the type of supraventricular tachycardia identified.

31. The cardiac pacing device of Claim 30 wherein the sensing means includes at least one electrode positioned in the heart and wherein the signal detection means is coupled to the electrode by a lead.

32. The cardiac pacing device of Claim 30 wherein the discrimination criteria include criteria for distinguishing between at least two different types of regular rapid heart rates due to a pacemaker anywhere above a ventricular level.

33. The cardiac pacing device of Claim 32 wherein the discrimination criteria include criteria for distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia.

34 The cardiac pacing device of Claim 33 wherein the discrimination criteria include criteria for distinguishing between fast atrial flutter at a first high rate and an other atrial flutter at a second lower rate.

35. The cardiac pacing device of Claim 30 wherein the discrimination criteria include rate-based discrimination criteria for distinguishing between different types of supraventricular tachycardia and wherein the processor compares a rate characteristic of the atrial activity signal to the discrimination criteria to identify the type of supraventricular tachycardia occurring.

36. The cardiac pacing device of Claim 30 wherein the discrimination criteria include morphology-based discrimination criteria for distinguishing between different types of supraventricular tachycardia and wherein the processor compares a morphology characteristic of the atrial activity signal to the discrimination criteria to identify the type of supraventricular tachycardia occurring.

37. The cardiac pacing device of Claim 30 wherein the discrimination criteria include a multi-dimensional threshold function, and wherein the processor compares a combination of a plurality of statistics calculated from a set of depolarization intervals determined from the atrial activity signal to the threshold function to identify the type of supraventricular tachycardia occurring.

38. The cardiac pacing device of Claim 30 wherein the processor comprises additionally means for monitoring an effect of controlling the pacer to provide pacing pulses to the heart in a manner corresponding to the type of supraventricular tachycardia identified, and means for adjusting automatically the discrimination criteria in response to the monitored effect.

39. The cardiac pacing device of Claim 30 wherein the processor controls the pacer to provide atrial antitachycardia pacing to the heart or an other type of pacing depending upon the type of supraventricular tachycardia identified.

40. The cardiac pacing device of Claim 39 wherein the other type of pacing is ventricular pacing.

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1 41. The cardiac pacing device of Claim 40 wherein the other type of
2 pacing is selected from the group of pacing controls consisting of ventricular rate
3 regulation and Rate Smoothing.

1 42. The cardiac pacing device of Claim 30 wherein the processor means
2 for comparing at least one characteristic of the atrial activity signal to the discrimination
3 criteria includes means for applying an atrial discrimination algorithm to the atrial activity
4 signal to produce an atrial discrimination algorithm output value indicative of the type of
5 supraventricular tachycardia occurring.

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1 43. The cardiac pacing device of Claim 42 wherein the processor
2 comprises additionally means for trending a plurality of the atrial discrimination algorithm
3 output values and for controlling the pacer to control timing of the pacing of the heart in
4 response to the trend of the atrial discrimination algorithm output values.

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1 44. A cardiac pacing device, comprising:
2 (a) sensing means for sensing activity of at least one of the atria of a
3 heart;
4 (b) signal detection means coupled to the sensing means for generating
5 an atrial activity signal based on the sensed activity of the heart;
6 (c) a pacer for providing pacing pulses to the heart; and
7 (d) a processor coupled to the signal detection means for receiving the
8 atrial activity signal and to the pacer for comparing at least one characteristic of the atrial
9 activity signal to discrimination criteria for distinguishing between fast atrial flutter and a
10 slower rate supraventricular tachycardia to identify whether a fast atrial flutter or a slower
11 rate supraventricular tachycardia is occurring and for controlling the pacer to provide atrial
12 antitachycardia pacing to the heart if a slower rate supraventricular tachycardia is identified
13 as occurring and to provide an other type of pacing if a fast atrial flutter is identified as
14 occurring.

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1 45. The cardiac pacing device of Claim 44 wherein the sensing means
2 includes at least one electrode positioned in the heart and wherein the signal detection
3 means is coupled to the electrode by a lead.

1 46. The cardiac pacing device of Claim 44 wherein the discrimination
2 criteria include criteria for distinguishing between the fast atrial flutter at a first high rate
3 and an other atrial flutter at a second lower rate.

1 47. The cardiac pacing device of Claim 44 wherein the discrimination
2 criteria include rate-based discrimination criteria for distinguishing between fast atrial
3 flutter and a slower rate supraventricular tachycardia and wherein the processor compares
4 a rate characteristic of the atrial activity signal to the discrimination criteria to identify
5 whether a fast atrial flutter or a slower rate supraventricular tachycardia is occurring.

1 48. The cardiac pacing device of Claim 44 wherein the discrimination
2 criteria include morphology-based discrimination criteria for distinguishing between fast
3 atrial flutter and a slower rate supraventricular tachycardia and wherein the processor
4 compares a morphology characteristic of the atrial activity signal to the discrimination
5 criteria to identify whether a fast atrial flutter or a slower rate supraventricular tachycardia
6 is occurring.

1 49. The cardiac pacing device of Claim 44 wherein the discrimination
2 criteria include a multi-dimensional threshold function, and wherein the processor
3 compares a combination of a plurality of statistics calculated from a set of depolarization
4 intervals determined from the atrial activity signal to the threshold function.

1 50. The cardiac pacing device of Claim 44 wherein the processor
2 comprises additionally means for monitoring an effect of controlling the pacer to provide
3 pacing pulses to the heart, and means for adjusting automatically the discrimination criteria
4 in response to the monitored effect.

1 51. The cardiac pacing device of Claim 44 wherein the other type of
2 pacing is ventricular pacing.

1 52. The cardiac pacing device of Claim 51 wherein the other type of
2 pacing is selected from the group of pacing controls consisting of ventricular rate
3 regulation and Rate Smoothing.

1 53. An implantable cardiac device, comprising:

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- 2 (a) sensing means for sensing activity of at least one of the atria of a
3 heart;
4 (b) signal detection means coupled to the sensing means for generating
5 an atrial activity signal based on the sensed activity of the atria of the heart; and
6 (c) a processor coupled to the signal detection means for receiving the
7 atrial activity signal and for applying an atrial discrimination algorithm including
8 discrimination criteria for distinguishing between different types of rapid regular
9 supraventricular tachycardia to the atrial activity signal to compare at least one
10 characteristic of the atrial activity signal to the discrimination criteria to identify the type of
11 rapid regular supraventricular tachycardia occurring and for providing an indication
12 corresponding to the type of rapid regular supraventricular tachycardia identified.

1 54. The implantable cardiac device of Claim 53 wherein the sensing
2 means includes at least one electrode positioned in the heart and wherein the signal
3 detection means is coupled to the electrode by a lead.

1 55. The implantable cardiac device of Claim 53 wherein the atrial
2 discrimination algorithm includes discrimination criteria for distinguishing between fast
3 atrial flutter and a slower rate rapid regular supraventricular tachycardia.

1 56. The implantable cardiac device of Claim 55 wherein the atrial
2 discrimination algorithm includes discrimination criteria for distinguishing between fast
3 atrial flutter at a first high rate and an other atrial flutter at a second lower rate.

1 57. The implantable cardiac device of Claim 53 wherein the atrial
2 discrimination algorithm includes rate-based discrimination criteria for distinguishing
3 between different types of rapid regular supraventricular tachycardia and wherein the
4 processor compares a rate characteristic of the atrial activity signal to the discrimination
5 criteria to identify the type of rapid regular supraventricular tachycardia occurring.

1 58. The implantable cardiac device of Claim 53 wherein the atrial
2 discrimination algorithm includes morphology-based discrimination criteria for
3 distinguishing between different types of rapid regular supraventricular tachycardia and
4 wherein the processor compares a morphology characteristic of the atrial activity signal to

5 the discrimination criteria to identify the type of rapid regular supraventricular tachycardia
6 occurring.

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1 59. The implantable cardiac device of Claim 53 wherein the atrial
2 discrimination algorithm includes a multi-dimensional threshold function and wherein the
3 processor compares a combination of a plurality of statistics calculated from a set of
4 depolarization intervals determined from the atrial activity signal to the threshold function
5 to identify the type of rapid regular supraventricular tachycardia occurring.

1 60. The implantable cardiac device of Claim 53 comprising additionally a
2 pacer for providing pacing pulses to the heart and wherein the processor is coupled to the
3 pacer for controlling the pacer to provide pacing of the heart in a manner corresponding to
4 the type of supraventricular tachycardia identified.

1 61. The implantable cardiac device of Claim 60 wherein the pacer is dual
2 chamber bradycardia pacer for providing pacing pulses to ventricles of the heart at a pacing
3 rate based on a detected atrial rate up to a maximum atrial tracking rate and wherein the
4 processor applies the atrial detection algorithm to the atrial activity signal only if the
5 detected atrial rate exceeds the maximum atrial tracking rate.

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